PERFORMANCE OF SUGARCANE BAGASSE ACTIVATED CARBON IN REMOVING OIL AND GREASE FROM WASTEWATER

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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ABSTRAK

Minyak dan gris adalah salah satu contoh pencemar yang boleh menyebabkan masalah alam sekitar yang teruk. Kepekatan minyak dan gris tertinggi di dalam sistem pembetungan boleh mengakibatkan penyumbatan di dalam pembetung yang menjurus kepada berlakunya limpahan. Terdapat pelbagai kaedah penyingkiran minyak dan gris; salah satu daripada contohnya adalah dengan menggunakan kaedah penyerapan. Kaedah ini biasanya menggunakan karbon aktif yang merupakan salah satu penyerap yang berkesan. Walaubagaimanapun, kos kepada karbon aktif adalah mahal justeru kajian dilakukan dengan menggunakan hasil buangan pertanian sebagai penyerap alternatif. Objektif kajian ini adalah untuk menentukan kapasiti optimum karbon aktif aktif (SBAC) tebu sebagai bio-penyerap dalam merawat air kumbahan domestik. Selain itu, ia juga bertujuan untuk membandingkan kesan saiz, dos penyerap, nilai awalan pH sampel air buangan dan jangka masa tindak balas dalam penyingkiran minyak dan gris. Kajian ini juga menganalisis kajian penyerapan berdasarkan dos, tahap pH dan jangka masa tindak balas dengan menggunakan persamaan penyerapan Langmuir. Model penyerapan Langmuir yang digunakan disahkan oleh plot kesamaan Ce / qe terhadap Ce. Keputusan menunjukkan bahawa kapasiti penyerapan optimum untuk kedua-dua 600μm dan 1.18mm SBAC adalah 3.0g dengan tahap pH 4 untuk 600μm SBAC dan tahap pH 8 untuk 1.18mm SBAC. Sementara itu, dari segi kesan tindak balas masa menunjukkan bahawa kedua-dua saiz SBAC menyerap dengan kadar penyerapan meningkat secara beransur-ansur dan mencapai penyerapan optimum selepas 90 minit bertindak balas. Kajian ini mendedahkan bahawa saiz terbaik SBAC yang boleh digunakan sebagai penyerap minyak dan gris adalah 600μm kerana ia dapat menyerap lebih banyak zarah minyak dan gris berbanding 1.18mm SBAC.

ABSTRACT

Oil and grease are one of the examples of a pollutant that can cause a severe environmental problem. The highest concentration of oil and grease inside the sewer system can cause the sewer to clog that can lead to overflow. There are various methods of oil and grease removal; one of the examples is by using adsorption method. This method commonly uses activated carbon that is one of the effective adsorbents. However, the cost for activated carbon is expensive and therefore a study was conducted by using agricultural residues as alternative adsorbents. The main objective of this study was to determine the optimum capacity of sugarcane bagasse activated carbon (SBAC) as bio-adsorbent in treating domestic wastewater. Besides, it also aims to compare the effect of size, adsorbent dosage, initial pH value of wastewater sample and contact time in the removal of oil and grease. This study also analyse the adsorption study based on dosage, pH level and contact time by using Langmuir adsorption equation. Langmuir adsorption model was used which is confirmed by a linear plot of Ce/qe against Ce. The results showed that optimum adsorption capacity for both 600µm and 1.18mm of SBAC are 3.0g with the pH level 4 for 600µm of SBAC and pH level 8 for 1.18mm of SBAC. Meanwhile, in term of contact time effect shows that both of SBAC sizes adsorbent adsorption rate increase gradually and reach optimum adsorption after 90 minutes of contact time. This study revealed that the best size of SBAC that can be used as an adsorbent of oil and grease is 600µm as it can absorb more oil and grease particles compare to 1.18mm of SBAC.

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LIST OF SYMBOLS

µm	Micrometre
mm	Millimetre
°C	Degree Celcius
%	Percentage
b	Constant that related to the affinity of binding sites
C_e	Equilibrium concentration
q_e	Equilibrium adsorption capacity
Q_o	Maximum amount of pollutant per unit weight of adsorbent
R^2	Equilibrium parameter

LIST OF ABBREVIATIONS

DOE	Department of Environment
EAC	Extruded Activated Carbon
EQA	Environment Quality Act
FKASA	Fakulti Kejuruteraan Awam dan Sumber Alam
GAC	Granular Activated Carbon
PAC	Powder Activated Carbon
SBAC	Sugarcane Bagasse Activated Carbon

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Water is a common chemical substance that is important to all forms or life especially to human being. Availability of water to our human population in the world for cleaning purpose is directly can control and reduce the possibility for disease to spread. While the world's population tripled in the 20th century, the use of renewable water resources has grown six-fold. Now, the world population keep increasing and will achieve 40-50% more population within the next fifty years. This population growth together with the urbanization and industrialization of the country also influence the increasing demand of clean water that also in the same time create serious consequences on of water resources (World Water Council, 2008). Although the earth covers by the water by 70%, but only 2.5% of the earth's water is freshwater and the balance of it is saline and ocean-based. Even then, only 1% of our freshwater easy to access with much of it trapped as snowfields and glaciers (National Geographic, 2018).

Wastewater is the water that has been affected by human use that came from combination of domestic, industrial, commercial or agricultural activities. It also came due to surface runoff or storm water and any sewer inflow or sewer infiltration. (Tilley *et al.*, 2014). There are several resources of wastewater including the domestic wastewater from households, municipal wastewater from the communities and also wastewater from industrial activities. Wastewater characteristics, which depend on wastewater source, are increasingly and becoming more toxic in recent times (Alade *et al.*, 2011).

One of the main sources that contribute to the water problem is caused by the present of oil and grease. Oil and grease is a measure of variety of sub-stances that

come from several different types of sources, for example: fuels, motor oil, cooking oil, animal-derived fats and oils, hydraulic oil, etc. It actually has become one of the critical components of the contaminant load especially in urban area which affect the quality of the water. These contaminants could cause many impacts towards the environment including clogging and fouling inside the sewer and drainage system.

To treat wastewater that contain oil and grease, the common treatment that been used is by using adsorbent such as activated carbon. However, due to the high price of activated carbon from the industrial market, it affects the effectiveness of the treatment in term of cost usage. Previous study by (Yakout and El-deen, 2016) , (Kouotou *et al.*, 2013) and (Bachrun *et al.,* 2016), reported that activated carbons can be produced also from virtually any type of carbonaceous materials such as sugarcane bagasse, coconut shell, palm shell, olive stones, oil-palm stones, agricultural wastes, and many others. This bio activated carbon not only can reduce the quantity of waste production but also give advantage in cost saving purposed.

Sugarcane bagasse is suitable for preparing activated carbons due to their excellent natural structure and low ash content. It is a byproduct of sugarcane industries obtained after the extraction of juice for production of sugar. Conversion of sugarcane bagasse into activated carbons which can be used as adsorbents, ion exchange, carbon molecular sieve, catalyst would add value to these agricultural commodities, help reduce the cost of waste disposal, and provide a potentially cheap alternative to existing commercial carbons for wastewater treatment purpose (Bachrun *et al.,* 2016).

1.2 Problem Statement

The major problem that usually occurs in the sewerage pipeline system is the high concentration of oil and grease that contain inside the wastewater that actually increase the possibility of clogging. Oil and grease enters the sewer system mostly comes from restaurants, residential area and also from industrial food facilities. It will continuously build up inside our sewer system when it release into the system and causes eventual blockage of sewer pipe (Husain *et al.*, 2014). At the same time, the present of grease traps may also fail to retain huge amount of dissolved and emulsified the oil and grease efficiently. Consequently, the oil and grease that not properly treated

by wastewater treatment process may enter the rivers and oceans that causing potentially detrimental environment impacts such as water pollutant (Peng, 2010).

One way to remove oil and grease from the wastewater is by using activated carbon as the wastewater treatment. Although it gives effective result as adsorption material for oil and grease but unfortunately the cost for activated carbon is expensive. There are many types or characteristic of activated carbon used in previous study such as sugarcane bagasse activation carbon as the alternative adsorbents for oil and grease removal because sugarcane bagasse is high available material in Malaysia (Thuan *et al.*, 2016). Most of the agricultural wastes including sugarcane bagasse are dump to the landfill instead of being used as other purposes.

Moreover, the different environmental parameters such as pH, sizes, adsorbent dosage, contact time, and the morphological analysis actually affect the optimum efficiency of the adsorbent to adsorb the oil and grease particles. This study was conducted by using agricultural residue as alternative adsorbents for oil and grease removal (Sa *et al.*, 2016). It significantly can help the agricultural industry to reduce the production of waste that been produced year by year. Besides, the efficiency of sugarcane bagasse activated carbon as natural adsorbent might help to reduce the cost that had been spend on the usage of existing activated carbon previously. Thus, it is significant to study on characterization and optimization of sugarcane bagasse activated carbon in both powder and granular forms towards the removal of oil and grease from the wastewater. The adsorbent sizes of powder and granular tends to give different performance towards the oil and grease removal.

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